NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, DC 20594

HUMAN PERFORMANCE GROUP CHAIRMAN'S FACTUAL REPORT

LOCATION & DATES
DCA01MM022

A. ACCIDENT

Accident No.	DCA-01-MM-022
Vessels Involved:	USS Greenville, MV Ehime Maru
Location:	About 9 miles south of Oahu, Hawaii
Date:	February 9, 2001
Time:	1343 HST[1]

B. OPERATIONS/HUMAN PERFORMANCE GROUP

Tom Roth-Roffy, NTSB, Operations Group Chairman
Will Woody, NTSB, Human Performance Specialist
Barry Strauch, NTSB, Human Performance Specialist
Lt. Charlie Johnson, US Coast Guard
Lt. Commander Rick Santamauro, US Navy
Commander John Caccivio, US Navy
Capt. Tom Kyle, US Navy

C. Summary

On February 9, 2001, at 1343 local time, the USS Greenville, (SSN 772), a Los Angeles class submarine, collided with the Japanese Motor Vessel, Ehime Maru, about 9 miles south of Oahu, Hawaii. The Ehime Maru, engaged in teaching Japanese high school students the fishing trade, was traveling at 11 knots, on a course of 166^{o}, en route to a fishing area. The Greenville was engaged in a distinguished visitor cruise, a Navy program that invites civilians to observe actual operations aboard its vessels. The Greenville struck the Ehime Maru as it completed an emergency surfacing maneuver from a depth of about 400 feet. The Ehime Maru was damaged and sank as a result of the collision. Thirty five people were onboard the Ehime Maru. The bodies of eight were found when the vessel was retrieved from the ocean floor. A ninth was missing and is presumed to have been killed in the accident. The Greenville was damaged but was able to return to Pearl Harbor under its own power. There were no injuries to any of the persons on board.

[1] All times are in Hawaiian Standard Time as read on a 24-hour clock, unless specifically noted.

D. Report

Because the Ehime Maru was struck by the Greenville after the fishing vessel had been maintaining a steady course of 166° at 11 knots, and because the Ehime Maru could not have seen the submerged submarine, it was not considered to have a role in the cause of this accident. Consequently, the human performance activities focused on critical crewmembers on the Greenville and their actions and decisions, the adequacy of the U.S. Navy's procedures governing the Greenville's operations and of its oversight of the Greenville's operations.

72-Hour History

The executive officer of the Greenville indicated that on the day of the accident he awoke at 0400, conducted administrative preparation from 0500 to 0800, performed his duties on the Greenville from the time the vessel embarked until lunch at 1150, and concluded his lunch at 1245. The day before the accident he awoke at 0500, from 0600 to 1130 practiced a simulated Tomahawk strike, ate lunch from 1130 to 1230, was in the control room simulator from 1230 to 1530, performed administrative activities from 1530 to 1800, ate dinner from 1800 to 1830, performed administrative activities from 1830 to 2000 and spent time with his family from 2000, until he went to sleep at 2200. The day before that, on February 7, he awoke at 0530, was involved in physical training from 0630 to 0715, drove to work and from 0800 until 1130 was in lecture training, ate lunch from 1130 to 1230, was in the control room simulator from 1230 to 1530, performed administrative tasks from 1530 to 1830, went home and relaxed with his family from 1830 until he went to sleep at 2200.

The sonar Supervisor on duty at the time of the collision indicated that on the day of the accident he awoke at 0230 and at 0330 was involved in preparations for the embarkation. He ate lunch from 1130 to 1230. The day before the accident he awoke at 0530, was on duty from 0630 until lunch at 1130, ate lunch from 1130 to 1230, and continued working until 2100. He went to sleep at 2200. The date before that, February 7, he awoke at 0530, performed physical training at 0630, reported for work at 0800, at lunch from 1130 to 1230, was involved in training from 1230 until 1900, at dinner at 1900, and went to sleep at 2130.

The CO and OOD were asked to supply this information and to be interviewed by Safety Board personnel in conjunction with its investigation of this accident. Both declined to cooperate with the Safety Board, on the grounds of their constitutional right to protect themselves against self-incrimination, because of the possibility of their facing a Navy court martial in conjunction with the events of this accident.

Toxicological Tests

On February 10, 2001, at the request of the United States Coast Guard, the Navy conducted a urine analysis of 25 of the Greenville's crewmembers on duty at the time of the accident. These included the Officer of the Deck, the sonar supervisor, and the fire

control technician (FTOW) at the time of the collision, the commanding officer and the executive officer. The testing, conducted by the Navy Drug Lab, San Diego, California, screened for: THC, Cocaine, Opiates (morphine, codeine, and heroin), LSD, and amphetamines. The results of all tests were reported as negative.

History of the Cruise

The Greenville had departed Pearl Harbor on the morning of February 9 to conduct a distinguished visitor (DV) cruise for 16 civilians and 1 Navy captain, the Chief of Staff of SUBPAC, the Navy's submarine force in the Pacific. The request for the DV cruise had originated with the former Commander in Chief of the Navy's Pacific Fleet. During the Navy's Court of Inquiry into the collision, the attorney for the commander officer (CO) of the Greenville alleged that the Secretary of the Navy had also expressed an interest in this DV cruise.

The plan for Greenville's underway on February 9 called for an approximate 0800 embarkation from its dock at Naval Station Pearl Harbor, with a return to a point outside the harbor known as Poppa Hotel (PH) at 1400, and a return to its dock an hour later. The Greenville was to remain within an operations area (OPAREA) that the Navy had designated and delineated south of Oahu, bounded by 21^{o} 10'N, 19^{o} 40'N, 158^{o} 00'W, and 157^{o} 00'W. Its actual embarkation was at 0757. Because of the short duration of the underway, the CO permitted the mission to be completed with less than its full crew complement. Of its 17 officers and 125 enlisted personnel, 11 officers and 95 enlisted personnel were aboard the Greenville on February 9. These included six sonarmen and and two firecontrol technicians. The chief sonarman and chief fire controlman remained in port .

Before the Greenville departed Pearl Harbor, the ship's navigator noticed that the Analog-Visual Signal Display Unit (AVSDU), a screen located in the overhead section of the raised periscope stand in the ship's control room which displayed sonar data of vessels being tracked, was inoperative. The navigation officer informed the CO that the AVSDU was out of commission, the captain acknowledged, but he subsequently testified that he did not remember being informed. Without the AVSDU, personnel in the control room had no direct means to observe sonar data on potentially conflicting vessels.

Greenville personnel testified that no special orders were issued to compensate for the loss of the AVSDU. At the Navy's Court of Inquiry two admirals, involved in oversight of the Navy's submarine program, gave their opinions regarding the loss of the AVSDU. One stated that he believed that the importance of this instrument made it incumbent on the CO to develop a plan of additional action to increase crew vigilance to compensate for its loss. The other did not believe that the loss of the AVSDU affected the mission and that the loss was a "red herring."

The CO was at the bridge during the outbound transit from Pearl Harbor. At that time the sky was overcast, the seas were 3 to 4 feet, and the visibility was fair with much

low-lying haze. The Navigator stated that he observed two fishing vessels and could see a dark hull vessel without difficulty, but he had difficulty discerning the one with a light colored hull. At 1017, the Greenville submerged. In the time before lunch, the DVs were given tours of the Greenville. The DVs had been scheduled to have lunch from 1100 to 1200 but because the wardroom could seat no more than 10 people, lunch was changed to two seatings from 1045 to 1145 and 1145 to 1245.

The Greenville had maintained an approximately 180^{o} heading from about 1045. It reached the limit of the OPAREA about 1200 and then it reversed course to an approximately due north heading. This course would also have taken the Greenville back to Pearl Harbor.

The initial schedule had called for the Greenville, at 1230, to commence a series of steep pitch changes, known as “angles and dangles,” in which it proceeds through a series of rapid depth changes using steep angles. At 1300 it was to perform a rapid surfacing maneuver, known as an emergency main ballast tank blow. These maneuvers were pushed back because of the rescheduling of lunch.

Shortly after 1300 the Greenville’s executive officer (XO), the submarine’s second in command, entered the CO’s stateroom to inform him that the wardroom personnel were preparing to secure dishes in preparation for the angles and dangles evolution, and that the evolution could be performed shortly thereafter. They also reviewed the manning of key stations onboard and they decided to assign a more proficient person to the position of helmsman. The helmsman selected was the helmsman used at battle stations.

A few minutes later the Greenville’s navigation officer entered the CO’s stateroom to inform him that given its current position, it was unlikely to arrive at PH at its scheduled time of 1400. He suggested to the CO that they needed to “get going.” The CO, who was autographing photographs for the DVs, appeared to the navigation officer to be unconcerned about being late. He testified that he wanted to get the photographs signed. About that time the officer of the deck called to the engineering officer of the watch (EEOW) to ascertain when the plant water sampling would be completed. The CO overheard the conversation, then directly asked the EEOW how much time they needed to complete the sampling. They responded that they would need another 12 minutes to complete this. He told the Officer of the Deck to secure the samples and prepare the nuclear station for the angles and dangles.

The CO left his stateroom about 1314 and proceeded directly to the sonar room to assess the location of other vessels in the area. The angles maneuver began at 1316, about 45 minutes behind schedule. According to the testimony at the Navy’s Court of Inquiry, based on his observations in the sonar room, he believed that there were two vessels to the north of the Greenville. Upon leaving the sonar room he proceeded to the starboard side of the control room to review the fire control displays. He believed that the sonar data and fire control data were consistent. The DVs, the chief of staff, the CO, the officer of the deck, and the XO were in the control room at that time, with the requisite enlisted personnel to operate the Greenville’s controls. Several DVs were

standing in the space between the fire control officer of the watch (FTOW), and a bulkhead that supported the Contact Evaluation Plot (CEP), a plot of the FTOW's solutions for the location of vessels in the area, their heading and speed, relative to the Greenville's own position. Several Navy officials testified at the Court of Inquiry that in high workload conditions an additional person is assigned exclusively solely to maintain the CEP.

According to the FTOW, DVs who were standing between him and the location of the CEP prevented him from proceeding to the CEP to update it as the relative positions of the Greenville and vessels within range of the sonar changed. Therefore, he did not update it from 1310 through the time of the collision. The FTOW testified that the Greenville's procedures called for the FTOW to update the CEP every 10 minutes ordinarily and every five minutes when it was at periscope depth. The FTOW stated that he did not request permission from the OOD before ceasing to maintain the plot nor did he inform the OOD. He indicated that on other DV type cruises he had been unable to maintain the plot. Neither the OOD, the XO, nor the CO discussed the lack of the current CEP with the FTOW**.**

Data from the ship's sonar data indicates that sonar had identified and was tracking two vessels at that time, designated S12 and S13. The fire control solution for S13, later determined to have been the Ehime Maru, was of a course of 024^{o}, range of 15,000 yards, and speed 11 knots. In actuality, the fishing vessel was maintaining a course of 166^{o}, speed and range matched the fire control solution.

The Greenville began angles and dangles around 1316. At that time, the CO was standing immediately behind the diving officer of the watch (DOOW) on the port side of the Conn. The officer of the deck (OOD), the officer who was assigned to direct the ship's movements, was standing in the aft part of the Conn, between the two periscopes. The CO directed the OOD to station himself immediately behind the DOOW, and the OOD complied. The XO was standing just outside of the sonar room. The sonar room was manned by a supervisor and two operators. The FTOW was standing at his workstation, on the starboard side of the Conn. The helmsman, planesman, DOOW, and Chief of the Watch (COW), were at their stations at the forward end of the control room. The majority of the DVs and the Chief of Staff, were also in the control room. The CO was directly giving orders to the OOD on the ship's movements and therefore he was considered to have taken direct command of guiding the ship.

The Greenville completed angles and dangles about 1325. Shortly before completing them, the XO informed the CO that they would be late approaching their estimated time of arrival at PH. The CO told the XO, "I know what I am doing." At that time, sonar was still tracking two surface vessels, designated as S12 and S13. The FTOW solution for the range to S13 was 14,000 yards. In actuality, the Ehime Maru had closed to within 10,000 yards of the Greenville.

The Greenville then began a series of maneuvers involving hard left or right hard turns at a high speed. It completed these maneuvers about 1331. sonar was still tracking S12

and S13, although the fire control solution showed S 13 at 14,000 yards on a course of 024° when in actuality it was still maintaining its course of 166° at a distance of 6,000 yards.

The CO then directed the OOD to make preparations to proceed to periscope depth, and to be at that depth in 5 minutes. Preparations for going to periscope depth normally require performing target motion analysis (TMA), which involves a series of two legs per sonar contact and is designed to allow the FTOW, using the firecontrol system, to determine the range, course, and speed of all sonar contacts. At its Court of Inquiry two Navy experts on submarine operations testified that several factors influence the amount of time needed to conduct an effective TMA. These include, existing environment conditions, signal to noise ratio (SNR) of contacts, number of contacts and sensor data reliability. They believed that, at a minimum, effective TMA requires a submarine to perform two different courses, each about 3 to 5 minutes. In addition, when resuming its heading after performing TMA, sonar needed additional time to allow the contact "picture" of sounds from surface vessels to stabilize before the operators could accurately interpret sonar readings of the contacts so that reliable bearings are provided to the firecontrol system. The CO then went to his stateroom to retrieve an object that had fallen during the previous maneuvers. At 1331 the Greenville then conducted one TMA leg. The vessel then proceeded to hold a steady course of 340° and ascended to a depth of 150 feet. The vessel was steady on course 340° for about one minute 25 seconds and was slowing down at this time. While on a steady course 340° for one minute and 25 seconds, the bearing rate to S-13 increased to right 6°, but those in sonar and the FTOW did not observe this.

The CO left his stateroom and proceeded to the sonar room where he asked the sonar supervisor about contacts. The CO was told that they were holding two contacts. He then reentered the control room. The XO then entered sonar and observed the sonar screens. The XO remained in the sonar room during the ship's performance of "baffle clear" maneuvers, a series of course changes designed to allow sonar to observe the vessel contacts aft of the vessel, an area that would be "blind" to sonar because of the interference of the ship's own rudder noise with the acoustic signatures of other vessels.

The OOD then announced over the ship's intercom to prepare to come to periscope depth. The Greenville held the 340° course for about 90 seconds, and in this time ascended from 400 feet to 154 feet and slowed from 18 to 12.5 knots. At 1333 the CO ordered the ship to turn to a heading of 120° for the baffle clear. The fire control solution showed S13 to be on a course of 024° at a distance of 15,000. In actuality, S13 was proceeding on a course of 166° at a distance of 5,000 yards. At 1333:03, sonar detected a new contact, later identified as S14. From this time until 1334:48, sonar and the FTOW maintained contacts on 3 surface vessels, identified as S12, S13, and S14. The FTOW determined their respective ranges as 19,000 yards, 15,000 yards and 8,000 yards respectively. At 1334:48 contact with S12 was lost until several minutes after the collision.

One of the sonar operators was concerned about the proximity of a contact, later determined to have been S12. He entered the control room and discussed the matter with the FTOW. The FTOW reexamined his calculations on the bearing and location of S12 and determined that it was not a concern for the vessel. The sonar operator then mentioned his concern to the XO, who reviewed the sonar display and then the fire control system solutions, then returned to sonar. The XO and the sonar operator determined that S12 would not be a factor.

After steadying on the course of 120^{o} the OOD called for the "all contact report." The sonar supervisor responded by reporting contacts with S12, S13 and S14. However, the CO testified that he continued to believe that the sonar contact picture had not changed from the time that he visited sonar, when it was holding two contacts, to the all-contact report, when the sonar supervisor stated 3 contacts.

At 1336:45 the CO ordered the OOD to proceed to periscope depth. The OOD ordered the DOOW to ascend to 60 feet. At 1337:18 sonar had contact with 2 vessels, S13 and S14. The FTOW solution showed S13 as course 024^{o} and range of 16,000 yards. In actuality, its course was 166^{o} and its range was 3,000 yards at that time. The FTOW was actively engaged in determining a solution for S14, the new contact. At 1337:48 the FTOW determined a solution for S13 that showed the vessel within 4,000 yards of the Greenville. The CO's standing orders required that the FTOW notify him of all contacts 4,000 yards or less from the Greenville. The FTOW testified that "he was trying to get everything done" before the vessel reached periscope depth and failed to notice the 4,000 yard range of S13.

The CO testified that if the AVSDU had been working he would have seen the three contacts, S12, S13 and S14. Without the AVSDU he did not realize that S14 was a new contact because, as he testified, "I didn't have the Sierra number ingrained in my brain."

At 1338:40 the Greenville reached the periscope depth of 60 feet. The No. 2 periscope was raised and the OOD conducted 3 initial 360^{o} sweeps of the horizon in low power and did not visually detect any vessels. The periscope was experiencing wave hits at that time. The XO reentered the control room at that point, and remained in the forward starboard section of the control room until the collision. After he completed the three visual sweeps the OOD reported "No close contacts." The ESM, which detects electronic signals from the radar of surface vessels, also reported no close contacts. The CO took the periscope from the OOD. The sky was overcast and except for a black horizontal stripe on its smokestack, the Ehime Maru was white in color.

The CO asked the OOD to raise the ship a few feet and the OOD ordered the Greeneville to a depth of 58 feet. At that depth the CO could see over the swells. He looked down the 340^{o} bearing and down the 020^{o} bearing and did not see any vessels. He went to 12 power and did not see anything. He then returned to low power and continued visually scanning through the periscope and saw nothing. Ultimately the periscope was facing 120^{o}, the ship's heading as well at that point. After looking through the periscope for 16 seconds while at a depth of 58 feet the CO announced that he held

no visual contacts. The Greenville was at periscope depth a total of 66 seconds, from 1338:40 to 1339:46. The Ehime Maru had closed to within 2,500 feet of the Greenville at this time.

The periscope had a television camera that projected onto a PERIVIS screen, the image that the person looking through the periscope could see. None of those in the control room detected any vessels through the PERIVIS.

At 1339:46 the CO ordered the vessel to perform an "emergency deep." He announced that this was for training and he directed the OOD to make the depth 400 feet. As the vessel descended, the CO asked for a turn to 340^{o}, which would take the vessel towards PH. At that time the FTOW's solution for S13 showed it on a course of 141^{o} and a range of 3,000 yards, a closing course that was accurate. However, the FTOW testified that since he had heard both the CO and the OOD state that they had no visual contacts, and he did not see any through the PERIVIS, he assumed that his solution was not correct. Shortly after the collision he "outspotted" S13 to 9,000 yards and a speed of 99 knots, data that he knew could not be accurate.

The Greenville reached 400 feet at 1341:57. The Ehime Maru was less than 1,000 yards from the Greenville at that time. At 1342:25 the Greenville began its emergency surface maneuver. Once the maneuver began the vessel must surface. The collision occurred at 1343:15.

The CO testified that he was not in a rush to return to PH, although he was aware that they were behind schedule.

<u>OOD</u>

The OOD on duty at the time of the collision took over as OOD at 1143. By 1300 he was aware that the ship would not be able to meet its scheduled PH time. He did not mention this to the CO or XO, but he believes that the NAV did discuss this with the XO. Around the time that the XO informed the CO in his stateroom that they would be late for their scheduled arrival at PH. about 1306, the XO called the engineering officer of the watch (EEOW) and asked when the plant sampling would be finished. The CO, who was in his stateroom and who had overheard the conversation, picked up the intercom handset and asked the EEOW how much time they needed, and after the EEOW said 12 minutes, the CO told the OOD to order the sample secured and prepare the nuclear laboratory for angles.

At this time the OOD believed that the vessel had 3 surface contacts. Before the start of the angles and dangles he told the FTOW (who had briefly relieved the FTOW who was on the watch at the time of the collision), to forcefully report if a contact was close.

After the CO returned to the Control Station from sonar, after leaving his stateroom, he did not ask the OOD for the OOD's understanding of the surface contact picture. The

OOD remained in the control station from the time of the start of the angles and dangles maneuver to the time of the collision.

During the angles and dangles maneuver the OOD was standing directly behind the diving officer of the watch (DOOW). The CO directed the OOD during the maneuver and during the subsequent high-speed turns on the inputs to command to control the ship.

After the CO told him to go to periscope depth within 5 minutes, he ordered the ship's depth to rise from 400 to 150 feet, and to change its heading to 120°. At that heading sonar reported the same two contacts and he then took the ship to periscope depth. He ordered turns for 6 knots, reported to all stations that they were proceeding to periscope depth, tested the early warning receiver (EWR), adjusted RACs to the sail, and adjusted the speaker on the EWR. He also asked the DVs who were standing there to leave the control station.

He then raised the No. 2 periscope and completed 3 rapid 360° sweeps. Before he could complete the search the CO took the periscope and then the CO ordered the depth to 58 feet. When the CO looked out the periscope he monitored the PERIVIS, although not totally because some people were in his way. He did not observe any contacts.

Applicable Procedures

The Chief of the SUBPAC testified that the Navy had no specific procedures governing the conduct of DV cruises.

The CO testified that he was aware of the prohibition against taking the vessel to test depth (800 feet) and to its flank speed (25 knots), which is classified information, in the presence of people without the proper clearances, when he gave the orders to do so in the presence of the DVs. He did this in order to "fully demonstrate the capabilities of the submarine." He also admitted that he had done this before.

The CO asked the torpedoman to collect salt water and to put the salt water in oil sample bottles to commemorate the event for the DVs. He was planning to give the water sample bottles to the DVs as "a memento to provide them with something that they could remember their tour and their embark (p. 1686)."

The CO testified that the Greenville had completed a "4-month selected restricted availability" and he knew that the system used to perform an emergency blow was tight and secure. He ordered that the maneuver be performed "to demonstrate to the distinguished visitors what the submarine capability is during the course of an emergency ascent to the surface."

The CO's procedures for the Greenville called for a briefing to be given by the OOD before the ship was to proceed to periscope depth. That briefing was not given.

(Signed)____
Barry Strauch